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Cleaning Liquid Container with a Filter Element for a Cleaning Device

This invention relates to a cleaning liquid container of the type indicated in the prior-art portion of claim 1.

A cleaning liquid container of the type initially referred to is known from printed specification WO 98/35581. The replaceable cleaning liquid container filled with a cleaning liquid has an inlet and an outlet as well as a filter housing which projects into the cleaning liquid and is equipped with a filter element. Removably disposed in the interior of the filter housing are a conveying mechanism and a motor for driving the conveying mechanism. The solid particles which arise while cleaning a shaving head of a dry shaving apparatus flow with the cleaning liquid via the outlet into the interior of the cleaning liquid container and can be sucked up together with cleaning liquid by the conveying mechanism both before and after they settle to the bottom of the cleaning liquid container. In the course of being sucked up, these solid particles settle on the outer wall of the filter element, forming a so-called filter cake on the filter element and obstructing the sucking up of liquid by the conveying mechanism.

It is an object of the present invention to improve a cleaning liquid container of the type initially referred to.

According to the present invention this object is accomplished in a cleaning liquid container of the type initially referred to by the features of claim 1.

An essential advantage of the invention is that the cleaning liquid, which is contaminated with solid particles as it flows back from a cleaning device, is directed via a sedimentation

line leading from the inlet to the outlet in order to allow the entrained solid particles to settle. As the result of this sedimentation a large part of the solid particles settles from the cleaning liquid, forming a sediment along the line. Hence a major part of the solid particles does not reach the filter element, resulting in a significantly reduced amount of filter cake being formed on the filter element.

According to a preferred embodiment of the invention provision is made for the sedimentation line to be formed by disposing at least one wall element in the interior of the cleaning liquid container.

In a further aspect of this embodiment the wall element between the inlet and the outlet is disposed in such a way as to ensure a separation of inflowing cleaning liquid and of cleaning liquid adapted to be aspirated by a conveying mechanism.

According to another preferred embodiment of the invention provision is made for the length of the sedimentation line to be predeterminable by the shaping of the wall element. In a further aspect of this embodiment provision is made for the interior of the cleaning liquid container to be divisible by the wall element into at least one first chamber and one second chamber, for the inlet to be assigned to the first chamber and the outlet to the second chamber, and for an opening to connect the first and the second chamber.

A preferred embodiment of the invention is characterized in that at least one wall element constructed as an overflow wall is provided in the interior of the cleaning liquid container.

In a further aspect of this embodiment the overflow wall is provided in at least one first and/or one second chamber. A further embodiment is characterized in that the overflow wall is

provided in the opening which connects the first chamber to the second. The overflow wall is preferably constructed as a rib.

According to another preferred embodiment of the invention provision is made for wall elements constructed as ribs on at least one inner wall of the cleaning liquid container. In a further aspect of this embodiment the ribs are constructed as longitudinal partitions. A further embodiment is characterized in that the ribs are constructed as transverse partitions. An embodiment of the invention which is particularly suited for receiving and retaining segregated solid particles is characterized in that a honeycomb-type wall structure is formed by means of ribs. The honeycomb-type wall structure formed by means of ribs is preferably disposed on the housing floor wall of the cleaning liquid container.

A further embodiment of the invention is characterized in that at least one rib has comb teeth.

According to yet another embodiment of the invention provision is made for ribs on at least one longitudinal wall to allow solid particles to settle.

To create as long a sedimentation line as possible while using a wall element disposed in the interior of the cleaning liquid container, one embodiment of the invention provides for the inlet and the outlet to be disposed adjacent to each other in a common housing wall of the cleaning liquid container.

According to an alternative embodiment provision is made for the inlet and the outlet to be disposed in a spaced relationship to each other in a common housing wall of the cleaning liquid container, and for at least two wall elements, each with at least one opening, to be provided in the interior of the cleaning liquid container in order to form a long sedimentation line.

The cleaning liquid container of the present invention affords a plurality of advantages which will be explained in more detail in the following.

To sediment solid particles, e.g. stubble hairs, contained in a cleaning liquid, the interior of the cleaning liquid container is equipped with a filter element through which the cleaning liquid, having been used in several cleaning cycles, is aspirated by means of a conveying mechanism. To increase the number of cleaning cycles before the cleaning liquid container is replaced, the sedimentation of solid particles on the way from the inlet to the filter element is effected by a sedimentation line which is formed by suitably constructed and disposed wall elements. As the result of the sedimentation a large part of the solid particles is separated from the cleaning liquid and hence does not reach the filter element and is unable therefore to form any filter cake there. The longer the sedimentation line, the fewer the solid particles which directly reach the filter element. Furthermore, the sedimentation of solid particles can be optimized by way of the number of partition-type and rib-type wall elements fitted within the sedimentation line and by their arrangement and construction.

On account of the cleaning process, the cleaning liquid flowing back into the cleaning liquid container contains not only solid particles but also small air bubbles. These air bubbles rise and leave the cleaning liquid as it proceeds along the sedimentation line, enabling bubble-free cleaning liquid to be aspirated by the conveying mechanism and fed to the cleaning process.

Through the sedimentation of solid particles it is possible, with the same filter area, to significantly increase the number of cleaning cycles before needing to replace a cleaning liquid

container because the filter cake, which in time blocks the filter element, forms more slowly. With solid particles settling and accumulating on the wall elements disposed to form the sedimentation line, a substantially more efficient use of the cleaning liquid is ensured, particularly as the conveying mechanism can be immersed more deeply into the cleaning liquid container. Consequently, less than a third of the content of the cleaning liquid container remains in the cleaning liquid container for disposal when the cleaning liquid container is replaced after repeat use.

The sedimentation of solid particles is substantially promoted firstly by providing as long a flow path as possible for the cleaning liquid between the inlet 15, designed as the return opening, and the outlet 14, designed as the withdrawal opening. The arrangement of additional wall elements such as ribs and partitions in the interior of the cleaning liquid container causes said wall elements to act against the flow of the cleaning liquid, as the result of which the heavy constituents of the solid particles are separated from the liquid current. In addition it is possible to provide comb-type wall elements within the flow path, which in addition to the sedimentation line encourage the settling of solid particles. These rib-type and partition-type wall elements make the cleaning liquid container more rigid on the whole, preventing accordingly the cleaning liquid container from being deformed, particularly in transit. The honeycomb structure provided on the housing floor wall lends optimal rigidity to the cleaning liquid container with a minimum of material outlay, in addition to resulting in maximal sedimentation as a result of the numerous ribs forming the honeycomb structure. Furthermore, the ribs of the honeycomb structure prevent the already deposited dirt from being moved with the liquid current toward the filter element.

Further advantages and details of the present invention will become apparent from the subsequent description and the accompanying drawings illustrating preferred embodiments. In the drawings,

FIG. 1 is a longitudinal sectional view of a cleaning device with a replaceable cleaning liquid container;

FIG. 2 is a view of the upper housing wall of the cleaning liquid container showing an inlet and an outlet;

FIG. 3 is a perspective view of a cleaning liquid container with an inlet and an outlet;

FIG. 4 is a perspective view of the cleaning liquid container of FIG. 3 showing a part section through the upper housing wall, two longitudinal walls and a transverse wall connecting these, and through a wall element;

FIG. 5 is a view of one side of the housing floor wall equipped with a honeycomb-type wall structure and longitudinal partitions and transverse partitions;

FIG. 6 is a perspective view of a cleaning liquid container of FIG. 4 having a housing floor wall equipped with longitudinal partitions and transverse partitions;

FIG. 7 is a perspective view of a cleaning liquid container showing in longitudinal section and cross section the housing pot arranged on the housing floor wall;

FIG. 8 is a longitudinal sectional view of the cleaning liquid container, taken through the filter housing and an opening for the passage of a cleaning liquid;

FIG. 9 is a longitudinal sectional view of the cleaning liquid container, taken through the filter housing and an

opening for the passage of a cleaning liquid and an overflow wall provided in the opening; and

FIG. 10 is a longitudinal sectional view of the cleaning liquid container, taken through the filter housing and an opening for the passage of a cleaning liquid and an overflow wall with comb teeth, which is provided in the opening.

FIG. 1 shows a cleaning device RV for cleaning a shaving head SK of a shaving apparatus R with a housing 1, a holding device 2, a cleaning liquid container 3, a filter element 4, and a conveying mechanism 6 adapted to be driven by a motor 5 and having a supply pipe 7 leading to a cleaning cradle 8 and a liquid discharge conduit 9 leading from the cleaning cradle 8 to a replaceably disposed cleaning liquid container 3. The replaceable cleaning liquid container 3 with an integrated filter element 4 is arranged beneath the cleaning cradle 8 and above a wall 12 of the housing 1. The conveying mechanism 6 with the motor 5 is disposed in the cleaning device RV so that it can be removed from a filter housing 40 provided in the interior 10 of the cleaning liquid container 3 and can be inserted in said filter housing 40.

The inner curved face of the cleaning cradle 8 is shaped to conform approximately to the outer contour of a shaving head SK of a dry shaving apparatus R and receives only as much cleaning liquid as required for the particular cleaning operation. To support the shaving head SK it is possible for the bottom of the cleaning cradle 8 to be provided for example with two support elements 16 made of an elastic material. The cleaning cradle 3 has an overflow device 17 making sure that the cleaning liquid 11 in the cleaning cradle 3 does not exceed a certain level. This assures that only the shaving head SK or a part of the shaving head SK is surrounded by cleaning liquid 11 when the

cleaning device RV is in operation. In this embodiment the liquid discharge conduit 9 from the cleaning cradle 8 to the cleaning liquid container 3 is formed by an outlet 18 in the cleaning cradle 8, whose cross-sectional area of discharge can also be used to control the level of the cleaning liquid 11 in the cleaning cradle 8, and by an inlet 15 of, for example, a funnel-shaped configuration in the cleaning liquid container 3. The inlet 15 and the outlet 14 of the cleaning liquid container 3 can be closed by means of a closure - not shown - in order for example to transport the replaceable cleaning liquid container 3.

FIG. 2 shows a view of the housing wall 23 of the housing 20 of the cleaning liquid container 3. The inlet 15 and the outlet 14 are disposed adjacent to each other in the housing wall 23. Provision is also made for a filling opening 25 to fill the cleaning liquid container 3 with cleaning liquid 11 when the inlet 15 and the outlet 14 are closed by a closure. After the cleaning liquid container 3 is filled with cleaning liquid 11 the filling opening 25 is closed by means of a plug for example. Through the outlet 14 in the open state it is possible to see the cylindrically constructed wall of the filter housing 40 and the filter element 4 fastened to the end of the filter housing 40. Through the inlet 15 in the open state it is possible to see the housing floor wall 21, equipped with ribs 32, 33, 36, of the cleaning liquid container 3.

FIG. 3 shows a perspective view of the replaceable cleaning liquid container 3 of FIG. 2, on whose housing floor wall 21 is fastened the housing pot 22 in whose upper housing wall 23 are situated the inlet 15 and the outlet 14.

FIG. 4 shows a partial section through the upper housing wall 23 and through three of the circumferential side walls of

the housing pot 22, namely the longitudinal walls 27 and 28 and the transverse wall 26 of the cleaning liquid container 3. The partial section also runs through the middle of the outlet 14 serving as the withdrawal opening and through the filter housing 40 as well as through the inlet 15 serving as the return opening. The interior 10 of the cleaning liquid container 3 is divided by a wall element 30 into a first chamber 50 acting as an inflow compartment and a second chamber 51 acting as a suction compartment. The wall element 30 ends at a predetermined distance A - see FIG. 8 - to the transverse wall 26 of the cleaning liquid container 3, thus forming an opening 39 through which the cleaning liquid 11 is allowed to flow on its way from the inlet 15 associated with the first chamber 50 to the outlet 14 associated with the second chamber 51. In the interior 10 of the cleaning liquid container 3 provision is made for further wall elements along the sedimentation line leading from the inlet 15 to the outlet 14, which encourage solid particles to settle from the cleaning liquid 11. These wall elements are essentially constructed as ribs or partitions 31, 32, 33 and 36. Using the ribs 32, 33 and 36 it is possible to obtain various wall structures on the inner surface of the housing floor wall 21 of the cleaning liquid container 3.

The embodiment of FIG. 5 shows by way of example a combination of two different wall structures, namely a honeycomb-type wall structure obtained by means of the ribs 36 and having extend therethrough ribs 32 and 33 constructed as longitudinal partitions and transverse partitions. The ribs 32, 33 and 36 have a relatively low height, thus forming depressions in which the solid particles from the cleaning liquid 11 can settle and be retained by the ribs 32, 33 and 36. The wall elements constructed as ribs 31 - see FIG. 4 - are formed integrally with the longitudinal walls 27 and 28 of the cleaning liquid container 3 and extend for example as far as the transverse

partitions 33 on the housing floor wall 21 - see FIG. 5. The ribs 31 also encourage sedimentation, particularly the separation of solid particles from the liquid 11.

The wall element 30, which forms the sedimentation line and, by virtue of its shape, simultaneously determines the length of the sedimentation line, is fastened on the one hand partly to the inner surface of the housing wall 23 of the housing pot 22 and on the other hand partly to the housing floor wall 21 of the housing bottom, in such a way that a single-piece wall element 30 is formed after the housing pot 22 is joined to the housing floor wall 21 and a tight connection is subsequently made as by adhesive bonding and/or welding. The wall element 30 provided as a partition wall may be for example formed integrally with the housing pot 22 or with the housing floor wall 21. It will be understood that the shape of the wall element 30 is not restricted to the form illustrated in FIGS. 4 and 5. The length of extension of the wall element 30 may be varied, preferably extended, and with it the length of the sedimentation line by giving it a different shape, e.g. a sinuous shape.

The embodiment of a cleaning liquid container 3 of FIG. 6 differs from the embodiment of FIG. 4 in that the housing floor wall 21 is equipped for example with a rectangular wall structure made of ribs 32 and 33.

On the housing floor wall 21 a wall element constructed as a rib 37 is provided in the opening 39 between the wall element 30 and the transverse wall 26 in such a way that an overflow wall 34 - see FIGS. 6, 9 and 10 - is formed in the opening 39 - see FIG. 4 - and holds back for sedimentation any solid particles contained in the liquid 11 which are already at a level in the liquid flow that is below the top of the overflow wall.

FIG. 7 shows a section through the housing pot 22 disposed on the housing floor wall 21, namely through the inlet 15, the outlet 14 and through walls of the second chamber 51. The opening 39 provided between the transverse wall 26 and the wall element 30 extends as far as the honeycomb-type wall structure formed by the ribs 36, 32 and 33 and opens up a view from the second chamber 51 into the first chamber 50.

FIG. 8 shows a longitudinal section through a cleaning liquid container 3, namely through the circumferential side wall of the housing pot 22, through the wall of the filter housing 40, through the wall element 30, and through the housing floor wall 21. A wall structure made of wall elements in the form of ribs and/or partitions 32, 33, 36 is formed integrally with the housing floor wall 21 in the area of the filter housing 40. The filter housing 40 ends a relatively short distance from the housing floor wall 21, a filter element 4 being provided which closes the end of the filter housing 40 on the side close to the housing floor wall 21. A predetermined distance of the filter housing 40 and hence of the filter element 4 to the opposite housing floor wall 21 ensures that a sufficient amount of cleaning liquid 11 can be aspirated by the conveying mechanism 6 - see FIG. 1 - and fed to the cleaning cradle 8 via a supply pipe 7.

In the embodiment of FIG. 8 the opening 39 formed by the transverse wall 26 and the wall element 30 extends in vertical direction - direction of the arrow P - from the housing floor wall 21 as far as the upper housing wall 23, in which for example the filling opening 25 is provided.

Unlike the embodiment of a cleaning liquid container 3 according to FIG. 8, in the embodiment of FIG. 9 an overflow wall 34 formed by a rib 37 is provided in the opening 39 formed

by the wall element 30 and the transverse wall 26. The overflow wall 34 extends from the housing floor wall 21 toward the filling opening 25 - direction of the arrow P. Unlike the embodiment of FIG. 9, the overflow wall 34 formed as rib 37 is equipped with comb teeth.